URGENT – REPLY TO FINAL OFFICE ACTION

From **Proceedings of the 2007 SCIENTIFIC CONFERENCE ON OBSCURATION AND AEROSOL RESEARCH**, Battelle Eastern Science and Technology Center, Aberdeen, MD, 20 June 2007.

COLLECTION, DETECTION, AND IDENTIFICATION OF AEROSOLIZED SUBMICRON-SIZE VIRUS PARTICLES

Solomon Zaromb and Dennis Martell
Zaromb Research Corp., Burr Ridge, IL 60527

Charles H. Wick
U. S. Army ECBC, APG, MD 21010

Patrick McCubbin
Optimetrics, Inc., Bel Air, MD 21015

Nathan Schattke
Schattke Chemical Consulting, Yorkville, IL 60560

Kirkman R. Phelps
Consultant, Perryman, MD 21130

Present collection of aerosolized pathogens excludes particles of <1 micron. Because most single toxin or virus particles are smaller than 1 micron, their collection must be restricted to larger aggregates or to particles carried by dust or droplets. Once these settle out, break up or dry up, the remaining floating smaller aggregates or single virus or toxin particles are overlooked with present collectors.

A recently developed device based on wet electrostatic precipitation, WEP, collects 1-micron fluorescent beads at efficiencies of >80% and an air flow rate of 500 liters/minute. To test its applicability to submicron-size particles, a WEP instrument collected aerosolized and dried dilute suspensions of MS-2 phage. Tests of the collection liquid for MS-2 with the Army's Integrated Virus Detection System yielded efficiencies ranging from >15% to >90%.

Introduction

Present Defense Department requirements for bio-aerosol collectors exclude particles smaller than 1 micron, which includes most or all single toxin or virus particles whose collection must then be restricted to larger aggregates or to particles carried by dust or droplets. Once these settle out, break up or dry up, the remaining floating smaller aggregates or single virus or toxin particles, which must make up the vast majority of such hazardous constituents, are overlooked with present collectors.

Earlier beliefs that single virus particles can not be easily aerosolized and are not retained in the respiratory tract are contradicted by recent demonstrations that:

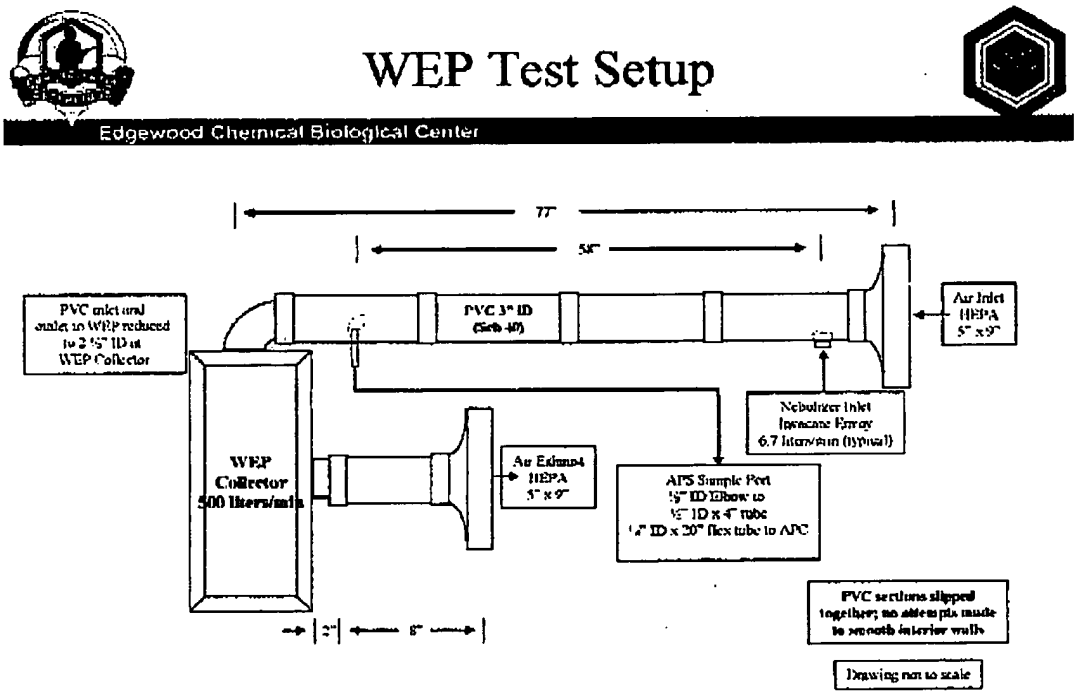
- Submicron viral aerosols can be created, albeit in small quantities thus far;[i]
- Submicron particles do get deposited in the lungs;[ii] and
- Their efficiency of capture by the lungs depends on their size, but the 100-nm particles have a capture efficiency of ~20%.[ii]

Smaller particles are thought to penetrate deeper in the lung where they can rapidly enter the blood stream.[2]

Therefore, the absence of efficient collectors for submicron particles may constitute a serious vulnerability to both viral attacks by enemy agents and to naturally generated viral aerosols.

Electrostatic precipitation-based devices have been known to capture particles ranging in size from <0.1 micron to >10 microns at efficiencies of >90%. A collector based on wet electrostatic precipitation [WEP], recently developed under an Army-sponsored SBIR project, collects 1-micron fluorescent beads at efficiencies of >80% and an air flow rate of 500 liters/minute.[iii] To test its ability to collect single virus particles, we used the setup of Fig 1 to aerosolize and dry dilute suspensions of an MS-2 phage and collect the aerosol with a WEP instrument.

Fig. 1



To verify that most of the droplets generated by the nebulizer have evaporated before reaching the WEP collector, we nebulized 5 ml of distilled water over a 5-minute period and sampled the air at the nebulizer outlet and WEP intake at half-minute intervals with an Aerodynamic Particle Sizer [APS]. The results are summarized in Figs. 2 and 3, which show that >98% of droplets ≥1 micron vanish before reaching the collector.